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FDS Fire Modelling Calculations in NPP Safety Related Pump Rooms

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In case of fire protection engineering the results of the experiments or detailed fire protection calculations can provide us with fire related parameters (heat release rates, temperature distribution, heat flux and smoke concentration), fire propagation pathways and fire spreading rates which can be used to evaluate potential for damage/unavailability of the equipment designated as targets in fire compartment. In this paper FDS (Fire Dynamics Simulator) CFD code was used to perform calculation for two similar Krsko NPP safety related pump rooms having simple geometry and rather low thermal loading. The verified and validated fire modelling methodology utilizing performance-based approach with calculations required input data and potential benefits of performing such calculations for different fire scenarios were demonstrated. The one of selected rooms is the room with centrifugal charging (CS) pump belonging to CVCS system. The other one is room with safety injection (SI) pump belonging to SI system. Both rooms, in first approximation, have rather limited communications with other areas what makes calculation easier (fire rated door and ducts without fire damper). The difference between those two rooms is that SI pump room has safety related HVAC system located inside the room, and HVAC system for CS pump room is located outside the room. Combustible inventory in both rooms is lube oil, electrical equipment (motor parts, el. panels) and cable insulation (power, instrumentation and control). The pump lubricating oil is assumed as an ignition source in analysed fire scenarios. In one scenario, the heat input is modelled using prescribed time dependent heat release rate (HRR), and in other scenario using lube oil chemical composition to estimate burning rates. The room door is normally closed (lower opening is modelled), but it is modelled opened in one scenario 10 min after ignition by the fire brigade. There is no automatic fire suppression system in the rooms. The goal of the calculations is to model fire development and related spatial influence to be able to assess the possible fire damage of electrical cables in modelled fire compartment (target objects damage using temperature damage criteria) and to calculate the temperature at fire detector position. The smoke distribution and soot density are calculated too. This kind of fire modelling and obtained results provides more flexibility in achieving established performance criteria (so called performance-based approach) during all phases of nuclear power plant operations and it is related to achieving required level of nuclear safety.

Keywords: *performance-based fire modelling, FDS, NPP safety related pump rooms, heat release rate, fire compartment*